



Physical Sciences

Advanced Magnetic Materials Methods and Numerical Models for Fluidization in Microgravity and Hypogravity

Solid wastes can be gasified for the recovery of valuable resources.

Lyndon B. Johnson Space Center, Houston, Texas

To support long-duration manned missions in space such as a permanent lunar base, Mars transit, or Mars Surface Mission, improved methods for the treatment of solid wastes, particularly methods that recover valuable resources, are needed. The ability to operate under microgravity and hypogravity conditions is essential to meet this objective. The utilization of magnetic forces to manipulate granular magnetic media has provided the means to treat solid wastes under variable gravity conditions by filtration using a consolidated magnetic media bed followed by thermal processing of the solid wastes in a fluidized bed reactor.

Non-uniform magnetic fields will produce a magnetic field gradient in a bed of magnetically susceptible media toward the distributor plate of a fluidized bed reactor. A correctly oriented magnetic field gradient will generate a downward direct force on magnetic media that can substitute for gravitational force in microgravity, or which may augment low levels of gravity, such as on the Moon or Mars. This approach is termed Gradient Magnetically Assisted Fluidization (G-MAFB), in which the magnitude of

the force on the fluidized media depends upon the intensity of the magnetic field (H), the intensity of the field gradient (dH/dz), and the magnetic susceptibility of the media. Fluidized beds based on the G-MAFB process can operate in any gravitational environment by tuning the magnetic field appropriately.

Magnetic materials and methods have been developed that enable G-MAFB operation under variable gravity conditions. Ferromagnetic, porous cobalt particles were prepared for use as filtration media. Magnetic body forces can be used to consolidate granular ferromagnetic media into a bed forming a depth filter for the separation of particulate matter from a gas or liquid stream. During filtration, such a depth filter can be expanded using these magnetic methods to create additional void space into which waste particles can be confined, thereby increasing filtration capacity. At the end of the filtration event, the bed can be fluidized to release a concentrated slug of particulate matter for processing elsewhere or can be employed as a fluidized gasification reactor. When used as a filter, G-MAFB methods result

in a regenerable particle filter, since entrained particles are released during fluidization, and after re-consolidation of the magnetic media, the bed is available for another filtration cycle.

G-MAFB methods combined with ferromagnetic catalyst media provide the basis for highly efficient, fluidized bed, catalytic reactors in which solid wastes can be gasified for the recovery of valuable resources. As such, fluidization of ferromagnetic catalyst particles at high temperature offers higher rates of mass transfer than are achievable in other reactors, whether fluidized or not, since the degree of bed expansion can be controlled using the magnetic force to augment gravity regardless of flow conditions. G-MAFB methods may also be used in a wide variety of other processes in which fluidization is employed for a variety of unit operations.

This work was done by James Atwater, Richard Wheeler, Jr., and James Akse of UMPQUA Research Company; and Goran Jovanovic and Brian Reed of Oregon State University for Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-24245-1

Data Transfer for Multiple Sensor Networks Over a Broad Temperature Range

Unique codes may be generated to distinguish among the signals from sensors coming in via a common medium.

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At extreme temperatures, cryogenic and over 300 °C, few electronic components are available to support intelligent data transfer over a common, linear combining medium. This innovation allows many sensors to operate on the same wire bus (or on the same airwaves or optical channel: any linearly combining medium), transmitting simultaneously, but individually re-

coverable at a node in a cooler part of the test area.

This innovation has been demonstrated using room-temperature silicon microcircuits as proxy. The microcircuits have analog functionality comparable to componentry designed using silicon carbide. Given a common, linearly combining medium, multiple sending units may transmit information simultaneously. A

listening node, using various techniques, can pick out the signal from a single sender, if it has unique qualities, e.g. a "voice." The problem being solved is commonly referred to as the cocktail party problem. The human brain uses the cocktail party effect when it is able to recognize and follow a single conversation in a party full of talkers and other noise sources.